# Why is an inquiry approach important in teaching Chemistry?

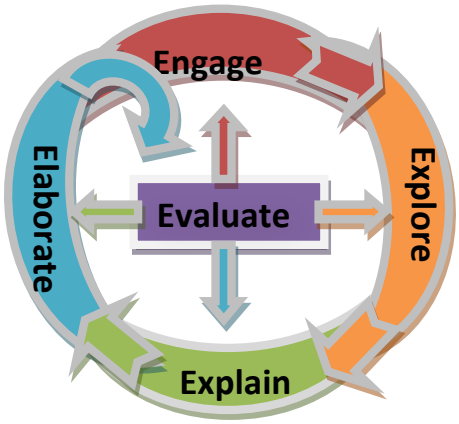
**First of all, what is guided inquiry chemistry and secondly, why should you want to teach it?**

## What is it?

Guided inquiry is a data-to-concepts approach to teaching chemistry. Chemistry education experts and notable high school chemistry teachers from Montana developed the curriculum.

Guided inquiry follows the 5E Learning Cycle (Bybee, R. W. et al, 1989):

- Engage
- Explore
- Explain
- Elaborate
- Evaluate




| Inquiry | | |
|---|---|---|
| Instructional Phase | **Goal** | **Cognitive Purpose** |
| Engage | **Elicit preconceptions; affective domain** | **Prepare for disequilibrium; motivational** |
| Explore | **Understand experimental design; collect data** | **Piagetian assimilation; disequilibration** |
| Explain | **Construct concept; introduce terminology** | **Piagetian accommodation; re-equilibration** |
| Elaborate | **Expand concept understanding; link new knowledge to old** | **Piagetian organization; up sophistication of concept** |
| Evaluate | **Assess students; identify areas of concern; revise curriculum** | **Piagetian organization; encourage further study** |

# Sample of the 5E cycle

***What is the Relationship between the Volume and Temperature of a Gas?***

## Engage

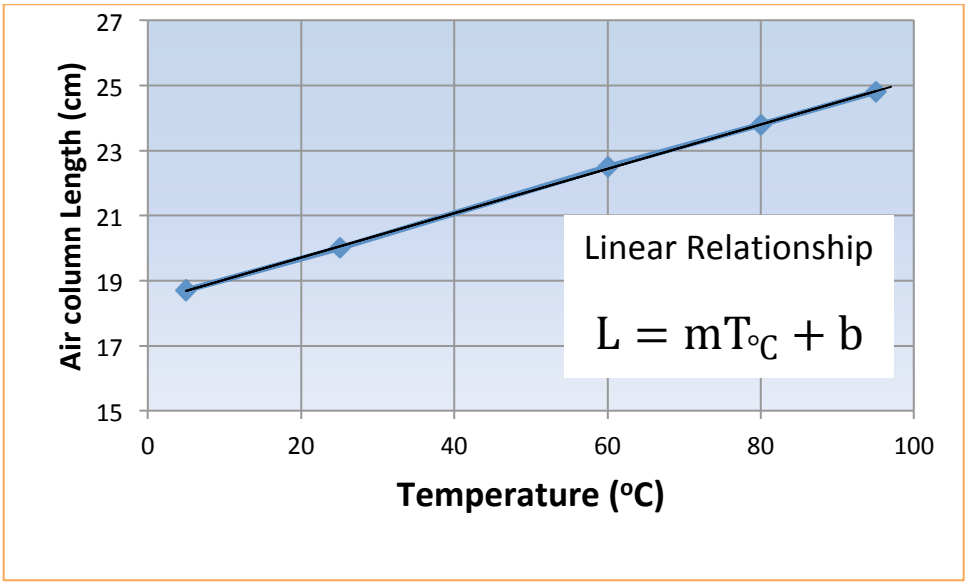
**Insert Picture (Tony Favero) - Teacher/class picture**

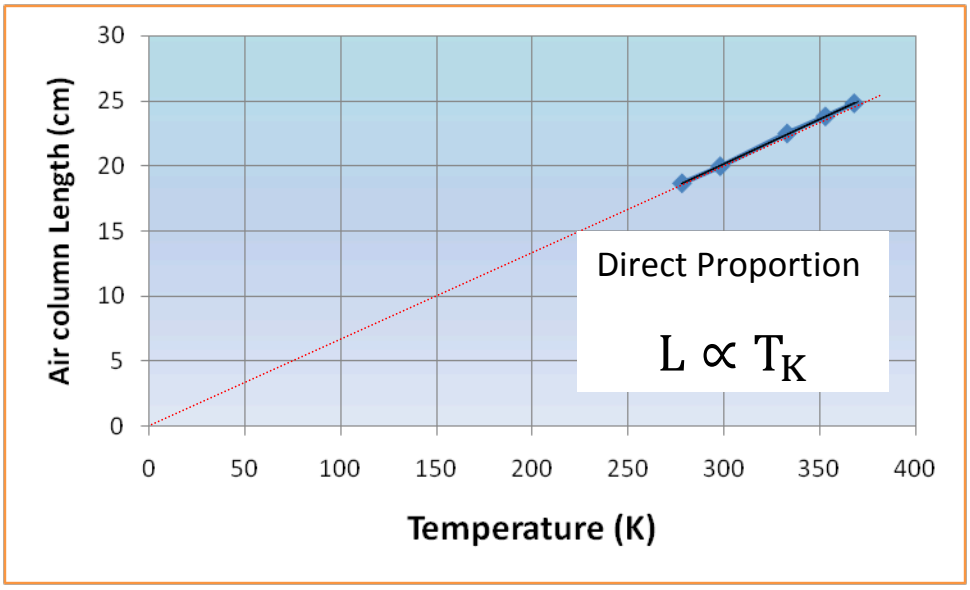
## Explore

**Insert Picture (Tony Favero) - Three students recording data**

# Explain

| Data | Length of Air Column *(cm)* | Temperature *(° C)* | Temperature *(K)* |
|---|---|---|---|
| **1.Ice Water** | **18.6** | **5.0** | **278** |
| **2. Room temperature** | **20.0** | **25.0** | **298** |
| **3. Warm water** | **22.3** | **60.0** | **333** |
| **4. Hot Water** | **23.7** | **80.0** | **353** |
| **5. Boiling water** | **24.7** | **95.0** | **368** |






$$L \propto T_K$$

$$V \propto T_K$$

$$V = k \times T_K$$

$$k = V / T_K$$

$$k = V_1/T_{K1} = V_2/T_{K2}$$

**Charles' Law**

# Why should I want to teach it?

## Guided inquiry

- **is based on brain development research**
- **increases student achievement**
- **raises IQs**
- **improves attendance and**
- **rejuvenates teachers**
- **is more closely attuned to the scientific method**

## (1) Increases student achievement

**We should use inquiry in the chemistry classroom because it can provide students with much more than content knowledge. Thinking skills can be taught!**

**What evidence is there that proves this increased student achievement?**

**Link to 0501 Results/Evidence**

## (2) Raises IQ's

**Listen to what team member John Deming has to say .**

**Insert Video - John #2 - Data transfer**

**(3) Improves attendance**

**Listen to what team member Leo Bird has to say.**

**Insert Video – Leo #1 – Increasing attendance**

**(4) Rejuvenates the teacher**

**Listen to what team member Paul Phillips has to say.**

**Insert Video – Paul #3 - Reinvigorated**

## How does it fit your goals?

**The curriculum**

- **is content driven**
- **aligns with state and national science standards**
- **incorporates *Indian Education For All* strategies**
- **engages students**
- **more attuned to the scientific method**

## (1) The units are content driven.

- **Each unit develops specific chemical concepts with elaborations and relevant connections made to previous and upcoming concepts.**
- **There is a defined set of mathematical, graphing and data analysis skills that are required of the student. These are used repeatedly throughout the units.**
- **Student misconceptions and preconceptions are identified early and addressed through concept development.**

## (2) The pedagogy is in direct alignment with national science standards that calls for the utilization of inquiry-based science instruction.

### Science as Inquiry Standards

In the vision presented by the *Standards*, inquiry is a step beyond "science as a process," in which students learn skills, such as observation, inference, and experimentation. The new vision includes the "processes of science" and requires that students combine processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science. Engaging students in inquiry helps students develop

- Understanding of scientific concepts.
- An appreciation of "how we know" what we know in science.
- Understanding of the nature of science.
- Skills necessary to become independent inquirers about the natural world.
- The dispositions to use the skills, abilities, and abilities, and attitudes associated with science.

http://www.nap.edu/openbook.php?record_id=4962&page=105

**(3) It incorporates *Indian Education for All* strategies**

**Listen to what team member Leo Bird has to say.**

**Insert Video – Leo #2 - Blackfeet Culture**

**(4) Inquiry-based instruction engages the student.**

- **The student is no longer just a passive listener.**
- **The student is responsible for interpreting data, drawing valid conclusions and concept development.**
- **The teacher acts a guide to give the student's thought process proper direction.**

**Listen to what team member Matt Antonich has to**

**Insert Video – Matt #1 - Head hurts**

| Approach | Who Does the Thinking? | Effect on Students' Thinking Skills |
|---|---|---|
| Concept → Data | Instructor/ Textbook Author | Limited |
| Data → Concept | Student | Meaningful and Significant |

**In traditional instruction students are told what to think and consequently very often science becomes a collection of facts.**

**Guided inquiry instruction uses a data to concepts approach so that students "make sense of data" and generate concepts, see science as a process and are allowed to *do* science.**

**(5) Inquiry instruction is much more closely attuned to the scientific method.**

| Scientific Method: Traditional versus Inquiry | | |
|---|---|---|
| **Scientific Method** | **Traditional** | **Inquiry** |
| • Observation<br>• Hypothesis<br>• Experiment<br>• Conclusions<br>• Theories | • Lecture / Inform<br>• Lab / Verify<br>• Homework / Practice | • Engage<br>• Explore<br>• Explain<br>• Homework/ Practice |